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Measurements of Astrophysical Opacities in the Laboratory*

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The OPAL opacity model has been used to solve several long standing puzzles in astrophysics, through a better treatment of the metal contribution to stellar opacity. Direct experimental verification of the opacity models has also been pursued at LLNL using the NOVA laser. The comparisons between theory and experiment clearly demonstrate the shortcomings of the older opacity calculations, but improvements in the experiments are necessary in order to discriminate between modern opacity codes. Particularly important is to perform experiments at very low density and temperature where line shape treatments give large differences in Rosseland mean opacities for astrophysical mixtures, and to test the range of validity for the unresolved transition array treatments. We are planning an experiment to test opacity models for the low density regimes of these stellar atmospheres. Experimental requirements are ultra high spectral resolution combined with large homogenous plasma sources lasting tens of nanoseconds, and with Planckian radiation fields. These requirements dovetail nicely with emerging pulsed power capabilities. We describe a high resolution measurement of the frequency dependent opacity, for ultra low density iron plasmas in radiatively driven equilibrium at the 500 kJ Saturn pulsed power facility.

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